

PB88-218433

Receptor Modeling Results from the
Integrated Air Cancer Project

(U.S.) Environmental Protection Agency
Research Triangle Park, NC

Jun 88



U.S. Department of Commerce
National Technical Information Service

NTIS

PB88-218433

EPA/600/D-88/127
June 1988

RECEPTOR MODELING RESULTS FROM THE INTEGRATED AIR CANCER PROJECT

by

C. W. Lewis, R. K. Stevens, R. E. Baumgardner,
R. B. Zweidinger, L. T. Cupitt, V. R. Highsmith,
L. D. Claxton, and J. Lewtas

U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

EPA Project Officer
Charles Lewis

ATMOSPHERIC SCIENCES RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO. EPA/600/D-88/127	2.	3. RECIPIENT'S ACCESSION NO. PD88 218433/AS
4. TITLE AND SUBTITLE RECEPTOR MODELING RESULTS FROM THE INTEGRATED AIR CANCER PROJECT		5. REPORT DATE June 1988
7. AUTHOR(S) C.W. Lewis, R.K. Stevens, R.E. Baumgardner, R.B. Zweidinger, L.T. Cupitt, V.R. Highsmith, L.D. Claxton, J. Lewtas		6. PERFORMING ORGANIZATION CODE
9. PERFORMING ORGANIZATION NAME AND ADDRESS Atmospheric Sciences Research Laboratory - RTP, NC Office of Research and Development U.S. Environmental Protection Agency Research Triangle Park, NC 27711		8. PERFORMING ORGANIZATION REPORT NO.
10. PROGRAM ELEMENT NO. A101/C/83/02-7022 (FY-88)		11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Atmospheric Sciences Research Laboratory - RTP, NC Office of Research and Development U.S. Environmental Protection Agency Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED
14. SPONSORING AGENCY CODE EPA/600/09		
15. SUPPLEMENTARY NOTES		
16. ABSTRACT EPA's Integrated Air Cancer Project has produced comprehensive wintertime ambient air data bases from three widely separated airsheds (Albuquerque, NM, Raleigh, NC, Boise, ID), which were anticipated to be heavily impacted by residential woodsmoke and motor vehicle emissions, but little else. Because of the simplicity of the airsheds a relatively simple multiple linear regression method using tracers based on potassium and lead or bromine has been successful in apportioning ambient fine particle extractable organics and mutagenicity. A comparison of receptor modeling results from all three cities shows a general consistency between the three cities, and with earlier mutagenic potency measurements from direct source testing.		
17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC	19. SECURITY CLASS (This Report) UNCLASSIFIED	21. NO. OF PAGES 9
	20. SECURITY CLASS (This page) UNCLASSIFIED	22. PRICE

NOTICE

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

RECEPTOR MODELING RESULTS FROM THE INTEGRATED AIR CANCER PROJECT

C.W. Lewis, R.K. Stevens, R.E. Baumgardner, R.B. Zweidinger, L.T. Cupitt,
V.R. Highsmith, L.D. Claxton, and J. Levitas

U.S. Environmental Protection Agency, Research Triangle Park, NC 27711

Introduction

The Integrated Air Cancer Project (IACP) is a long range research program of the U.S. EPA which has as one of its objectives, determining which emission sources are the major contributors of carcinogens in ambient air and providing quantitative estimates of their contributions. Unlike past efforts to identify airborne carcinogens which relied on source inventories, emission rates and production volumes of compounds which were potentially hazardous, the IACP takes the approach of measuring ambient mutagenicity (a surrogate for carcinogenicity) directly, identifying species responsible for it and apportioning it to source types. Thus receptor methodology is an integral part of the IACP strategy. In this article we summarize all available results on the source apportionment of mutagenicity and related quantities from the IACP.

Apportionment of Organic Matter and Mutagenicity

Since 1985 comprehensive wintertime field studies have been conducted in three U.S. cities, each selected for an anticipated high impact of residential woodsmoke. Sufficient aerosol data from these studies have now been analyzed to look for trends that may link these experiments. Table I summarizes all available source apportionment results for fine particle extractable organic matter (EOM) and the *S. typhimurium* TA98 $\pm$ S9 mutagenicities associated with EOM. The sampling and analytical procedures by which the EOM and mutagenicity measurements were made have been described elsewhere¹. Because of the presumed simplicity of the selected airsheds, and the restriction to only the extractable organic fraction of fine particle mass, a very simple two-source multiple linear regression (MLR) receptor model¹ was employed, which used fine particle lead and soil-corrected potassium as motor vehicle and woodsmoke tracers, respectively. The results of this statistical approach have been shown to be in good agreement with a deterministic approach using ¹⁴C, for the dozen or so sampling periods in which the two have been compared².

The four sites at which sufficient data were available to perform source apportionments of fine particle EOM and its $\pm$ S9 mutagenicity are identified in Table I. Of these only the Boise Fire Station site was located near a major roadway. All other sites were in residential neighborhoods where wood burning was prevalent. Mutagenic data are not yet available for the two Boise sites.

For the regressions on which Table I was based, day and night periods were grouped together for each site. In the case of the Boise data day and night periods for both sites were grouped together. Thus the good agreement in all cases between "Measured" and "Total" (Wood + Mobile + Other) is a gratifying result, since the comparisons are between smaller subsets of the data than were used in constructing the regression models. For the Raleigh data the smallness of the motor vehicle contribution did not allow accurate motor vehicle regression coefficients to be calculated for the EOM and +S9 regression models. Instead, these two coefficients were taken over from those found with the Albuquerque data set³.

Principal features of Table I are as follows:

EOM At each site the average woodsmoke contribution was always greater than the motor vehicle contribution, during both day and night, and even at the "roadway" site B(FS). The average woodsmoke contribution was always significantly greater at night than during the day. At each site the motor vehicle contribution showed little diurnal variation.

+S9 The average measured mutagenic concentration was always greater at night than during the day, which is related to the significantly greater contribution of woodsmoke at night along with the relatively unchanging motor vehicle contribution between day and night.

-S9 At each site the average contributions of motor vehicles to -S9 and +S9 mutagenic concentrations are similar. The average contributions of woodsmoke however are 2 - 6 times smaller for -S9 compared with +S9 mutagenicity. The -S9 mutagenicity is the only quantity in Table I for which the "Other" source contribution (i.e., the regression intercept) is always both large and statistically significant, amounting to as much as 61 % of the Raleigh daytime measured average. Boise mutagenicity data are expected to be helpful in examining this puzzling result.

Mutagenic Potencies

Table II shows the potencies of woodsmoke and motor vehicle emissions, obtained from Table I simply by taking the ratio of the average ambient revertant concentration to the average EOM concentration, separately for each site and source category. There is reasonable consistency between results at the two sites. Thus for +S9 the woodsmoke potency is of order 1 rev/ μ g, while for -S9 it is substantially smaller, averaging 0.3 rev/ μ g. For motor vehicles the +S9 and -S9 mutagenicities are similar and site independent, although with rather large uncertainties (the +S9 Raleigh value is not an independently derived result). The motor vehicle potencies are 2 - 3 times larger than the largest woodsmoke potency (+S9). The results of Table II generally follow the potencies that have been found in direct source testing¹. For the goals of the IACP however the results in Table II are the more relevant, because they implicitly include the effects of atmospheric transformation of mutagenicity, if any.

Conclusion

Fine particle residential woodsmoke and motor vehicle emissions source apportionment results have been summarized for EOM, TA98 +S9 mutagenicities and potencies from four sites in three U.S. cities studied in the IACP. There is general consistency between the results at different sites, and with earlier potency measurements from direct source testing. The most puzzling feature of the data is the large fraction of the ambient -S9 mutagenicity which is not accounted for by woodsmoke or motor vehicle emissions.

Although research described in this article has been funded by the U.S. Environmental Protection Agency, it has not been subjected to agency review and, therefore, does not necessarily reflect views of the Agency, and no official

endorsement should be inferred.

References

1. C.W. Lewis, R.E. Baumgardner, R.K. Stevens, L.D. Claxton, J. Levatas, "The contribution of woodsmoke and motor vehicle emissions to ambient aerosol mutagenicity," Envir. Sci. Technol., in press (1988).
2. L.A. Currie, K.R. Beebe, G.A. Klouda, "What should we measure? aerosol data: past and future," EPA/APCA Symposium on Measurement of Toxic and Related Air Pollutants, Raleigh, NC, May 1988.
3. R.K. Stevens, C.W. Lewis, T.G. Dzubay, R.E. Baumgardner, R.B. Zweidinger, V.R. Highsmith, L.T. Cupitt, J. Levatas, L.D. Claxton, L. Currie, G.A. Klouda, B. Zak, "Mutagenic atmospheric aerosol sources apportioned by receptor modeling," Proceedings, ASTM Boulder Conference, July, 1987 (in press).

Table I. Average Contributions to Ambient EOM and Mutagenicity Concentrations.

		EOM (ug/m ³)					
	Site ^a	N ^b	Wood	Mobile	Other	Total	Meas.
AM	A	18	5.2 ± 0.2	2.9 ± 0.8	1.0 ± 0.9	9.1	8.7
PM		26	21.5 ± 0.8	3.1 ± 0.9	1.0 ± 0.9	25.6	25.9
AM	R ^c	14	8.1 ± 0.3	0.9 ± 0.3	0.1 ± 0.8	9.1	8.5
PM		26	19.6 ± 0.7	1.2 ± 0.3	0.1 ± 0.8	20.9	21.4
AM	B(EGP)	24	11.6 ± 1.2	3.4 ± 0.9	1.7 ± 1.1	16.7	16.3
PM		23	16.8 ± 1.7	2.5 ± 0.6	1.7 ± 1.1	21.0	23.8
AM	B(FS)	25	8.2 ± 0.8	5.3 ± 1.3	1.7 ± 1.1	15.2	13.4
PM		25	16.1 ± 1.6	4.5 ± 1.1	1.7 ± 1.1	22.3	21.9
TA98 +S9 (revertants/m ³)							
AM	A	18	6.5 ± 0.7	10.4 ± 2.8	2.5 ± 3.1	19.4	21.1
PM		26	27.2 ± 2.8	11.4 ± 3.1	2.5 ± 3.1	41.1	39.9
AM	R ^c	14	6.3 ± 0.5	3.1 ± 0.8	1.4 ± 1.3	10.8	9.5
PM		26	15.3 ± 1.2	4.5 ± 1.2	1.4 ± 1.3	21.2	22.0
TA98 -S9 (revertants/m ³)							
AM	A	18	1.1 ± 0.3	6.9 ± 1.4	6.3 ± 1.6	14.3	15.2
PM		26	4.6 ± 1.4	7.5 ± 1.5	6.3 ± 1.6	18.4	17.9
AM	R	14	3.3 ± 0.7	3.2 ± 1.3	6.8 ± 1.4	13.3	11.2
PM		26	8.0 ± 1.7	4.6 ± 1.9	6.8 ± 1.4	19.4	20.5

^a A = Albuquerque, NM; R = Raleigh, NC; B(EGP) = Boise, ID (Elm Grove Park);
B(FS) = Boise, ID (Fire Station).

^b N = number of sampling periods.

^c lead regression coefficient from Albuquerque data.

Table II. Ambient Data-derived Mutagenic Potencies (revertants/ μ g EOM).

Site ^a	TA98 +S9	
	Wood	Mobile
A	1.3 $\pm$ 0.2	3.7 $\pm$ 1.5
R	0.78 $\pm$ 0.07	(3.7 $\pm$ 1.5) ^b
	TA98 -S9	
	Wood	Mobile
A	0.22 $\pm$ 0.07	2.4 $\pm$ 0.9
R	0.41 $\pm$ 0.09	3.7 $\pm$ 1.9

^a A = Albuquerque, NM; R = Raleigh, NC.

^b identical to Albuquerque result by assumption.